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(54) OIL-IN-WATER EMULSIONS

(71) We, UNILEVER LIMITED, a company organised under the laws of Great Britain, of Unilever House, Blackfriars, London E.C.4, England, do hereby declare

the invention for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to oil-in-water emulsions and processes for making them, and especially to oil-in-water emulsions of prolonged storage life which on whipping give a structure comparable with whipped dairy cream. Whipped dairy cream is a product which has been known for many years and which is very much appreciated by many people. The product is usually made some time before use by whipping a liquid fresh or pasteurized dairy cream after addition of sugar and/ or whipping agents. Sometimes a sterilized canned dairy cream is used which is often a semi-solid product due to fat aggregation.

Because dairy cream is rather expensive, filled creams have been proposed; filled creams are creams in which milk fat is replaced partly or wholly by other fats. For this purpose hardened vegetable fats are usually proposed, because unhardened vegetable fats are usually too liquid and have a detrimental effect on the structure of the whipped product. Sometimes the product could not be whipped at all in the presence of liquid fats (see for example M. E. Schulz in Milchwissenschaft, *26* (1971) 481—6, particularly paragraph VIII, which discloses that oils and fats, particularly above their melting points, and emulsions containing free fat, are foam-destroying ingredients of food products).

In recent years two tendencies have developed in this field. The first is based on research findings indicating that polyunsaturated fatty acids termed PUFA hereinafter have a favourable influence in the prevention and combatting of atherosclerosis and similar heart diseases. As a consequence manufacturers of fat-containing products are more and more developing and marketing products in which the fat contains a considerable proportion of polyunsaturated fatty acids, in particular linoleic acid. Thus, margarines, halvarines (which are margarine-like products containing about 40% fat instead of about 80% fat), and liquid coffee whiteners with a fat phase having a PUFA content of at least 40 mole % (i.e. at least 40% of the fatty acid radicals of the fat having two or more double bonds), are marketed in the Netherlands. In the literature also other products with high-PUFA fats have been described, for example yoghurt and cheese. However, in the preparation of whippable creams containing high-PUFA fats, serious difficulties can be encountered, because the higher PUFA content of the fat phase is accompanied by an increase of the proportion of liquid fat that decreases the whippability and the rigidity of the creams.

The second tendency is a result of changes in the distribution pattern of food products. In the past products such as milk, yoghurt, and cream, were offered by the milkman, who delivered the products to the consumer every day. Thus the shelf-life need only be a few days. With the introduction of self-service stores, refrigerators in many homes and centralized production in a few factories, a need arose for products having a longer keepability, i.e. 3 to 5 weeks at least at chilled cabinet temperatures (0—10°C) but preferably at room temperature (20—25°C). This tendency gives rise to the need for preserving methods because the storage life of dairy products is often limited due to microbiological spoilagle. Because preserving agents are not permitted in many countries, the industry has to develop sterilization or pasteurization methods to prepare products

with a prolonged storage life. Some products, such as milk, liquid coffee whiteners and custards, can be sterilized with out detrimental effects on their properties, but sterilization of cream has not become popular, owing to the easy development of a cooked milk flavour, which is disliked, and to the formation of fat lumps. Another method for improving the storage life of a product is pasteurization of an acidified product. In acid products microorganisms develop less easily than in neutral products and some permitted preserving agents such as sorbic acid are only effective in acid medium. In the preparation of whippable creams pasteurization of acid creams was not possible, because it is generally known that acid creams are not, or at most poorly, whippable if the pH is at a level of 4.9 or below (see for instance paragraph IV of the above cited review from the German dairy expert M. E. Sohulz, in which it is stated that products like whipping cream, cream preparations and filled creams lose their foamability at pH values of 4.9 and below).

In general, a cream is considered whippable if with normal household mixers and overrun of at least 70—80% can be obtained. The usual overrun varies from about 140 to about 300%.

Proteins are important ingredients in the preparation of cream, because they stabilise the dispersion of fat, both in a liquid emulsion and in a whipped emulsion. However, when casein is the main protein, as in natural cream, the stabilising action of the protein is strongly decreased at a pH in the neighbourhood of its isoelectric point, i.e. at a pH of about 4—5, because then casein coagulates. This coagulate is used in the preparation of sour cream containing not more than 25% fat as described in US Patents 3,355,298; 3,359,116 and 3,391,002. It is generally known that products such as sour cream are not whippable or only whippable to a limited extent, e.g. to an overrun of about 25%, which is not comparable with the usual overrun of whipping cream (about 100—300%).

Thus up to now it has not been possible to prepare acid, protein-containing, whippable creams.

The present invention is based on the discovery that an aqueous phase containing particular emulsifiers shows a good foam formation only within a distinct pH range. This finding seems to be connected with the state of the emulsifier in the aqueous phase. The foaming properties of the system appear to be dependent on the presence of a flocculate. It has been found that good foam formation can only be obtained if a flocculate of the emulsifier is present in the aqueous phase. It has further been found that the flocculate is not dispersed when a protein is present in the aqueous phase having a pH in the neighbourhood of the isoelectric point of the protein. It is believed that the flocculate becomes dispersed by the more ionised protein, if a protein is present in the aqueous phase having a pH far from the isoelectric point. It has now been found that whippable, protein-containing emulsion can be made having a pH in the range of 4.2—5.5.

The present invention provides an oil-in-water emulsion which has been pasteurized by heat comprising not more than 50% by weight fat and an aqueous phase having a pH of from 4.2 to 5.5 and containing from 0.5 to 4% globular protein, as hereinafter defined, by weight of the aqueous phase, less than 20% of the total amount of protein being coagulable, and a non-protein emulsifier of the type that forms a flocculate in water at the pH of the aqueous phase in an amount sufficient to retain dispersed gas when the emulsion is whipped.

In one form of the invention the emulsion has a fat content of from 3 to 25% by weight, and can be used as a low caloric cream with improved storage life and which can easily be whipped to a whipping cream having a good overrun and rigidity. In this embodiment the fat is preferably one having a relatively high percentage of solid phase at the whipping temperature, i.e. one having an extrapolated melting dilatation of at least 1500 mm^3/25g at 0°C. The dilatation of a fat is proportional to the solids content of the fat and can be determined by the method described in H. A. Boekenoogen; Analysis and Characterisation of Oils, Fats and Fat Products; vol. I, pages 143—145 and 155—156; Interscience Publishers 1964. The whipping temperature is preferably in the range of 0—10°C. Suitable fats are butterfat, vegetable and animal fats which are solid at room temperature, hydrogenated and/or interesterified fats, for example interesterified palm kernel oil, hydrogenated vegetable oils, having a melting point above 30°C.

In another form of the invention the emulsion has a fat content of from 25 to 50% by weight, particularly one in which the fat has a PUFA content of at least 30 mole %. In practice linoleic acid provides a major amount of the PUFA present. Suitable high PUFA fats are grapeseed oil, maize oil, safflower oil, soybean oil and sunflower oil. In order to improve the rigidity of the cream after whipping the fat preferably contains from 15 to 60% by weight fatty acid triglyceride hard-stock, that is, a fatty acid triglyceride having a melting point of at least 38°C. A suitable hard-stock is an interesterified palm kernel oil having a melting point of 39°C.

Although whippable emulsions can be obtained in the whole pH range of from 4.2

to 5.5, a range of from 4.6 to 5.4 is preferable, particularly for emulsions containing a fat phase with a high PUFA content, the range of from 4.7 to 5.0 being most preferable both for rigidity and taste of the cream. However, if the storage life of the product is to be as long as possible a pH range of from 4.2 to 4.9 is preferable in view of better microbiological stability.

Globular proteins are proteins which form stable colloidal solutions in water in the whole pH range of from 2.0 to 7.0, if required after addition of salt. Examples of these globular proteins are:

1) whey proteins, comprising beta-lactoglobulin, alpha-lactalbumin and serum albumin;
2) blood serum proteins, the main constituent (about 80%) of which is blood serum albumin;
3) egg-white proteins, of which the main components are ovalbumin, conalbumin and ovumucoid (J.Sci.Fd.Agri., *17* (1966), p. 101—111);
4) soya whey proteins;
5) proteins from wheat germ; and
6) egg-yolk and similar lipoproteins.

The amount of globular protein in the aqueous phase is preferably from 1.0 to 2.5% by weight. Whey protein is preferable, because its heat stability is such that an emulsion containing whey protein can be pasteurised without appreciable coagulation of whey protein, and because it is a by-product in dairy manufacture having a high nutritional value which can be used in food manufacture. However the heat stability of whey protein and other globular proteins will be improved if at least part of the globular protein is present in the form of a complex with an anionic polysaccharide such as carrageenan, sodium alginate and carboxymethylcellulose (CMC). Because CMC is not permitted by food legislation in some countries and because the complexes of CMC and whey proteins have less buffering capacity, which is important for the taste of the product, complexes of globular proteins with algal anionic polysaccharides, such as carrageenan and sodium alginate are preferable. When very heat-sensitive globular proteins such as egg-white proteins are used, it is especially valuable to have substantially all globular protein present in the form of a complex with an algal anionic polysaccharide, but even for less heat-sensitive globular proteins to use of fully-complexed globular proteins is advantageous for improving the taste of the product. When a complex of a globular protein and an algal anionic polysaccharide is used in an emulsion according to the present invention, this provides a form of the invention described and claimed in British Patent Specification No. 23,339/72 (Serial No. 1,440,181) in which the preparation of the complexes is described in detail.

As stated above the presence of a substantial amount of coagulated protein, as for example in sour cream, destroys almost completely the whippability of the emulsion. Therefore the present emulsion contain globular protein in the absence of substantial amounts i.e. less than 20%, of coagulated protein. Less than 20% of coagulable protein by weight of the total protein content is not necessarily harmful for the whippability.

The non-protein emulsifier is preferably present in an amount of from 0.3 to 2.0% by weight of the emulsion, a range of from 0.5 to 1.0% being most preferable. Suitable emulsifiers that form a flocculate in water at the pH of the aqueous phase are nonionic emulsifiers such as partial fatty acid esters of polyalcohols, for example glycerol and propylene glycol, and glycerolactopalmitate. Preferably partial palmitic acid glycerides are used as an emulsifier. Both partial fatty acid glycerides having a monoglyceride content of above 90% (so-called "high monoglycerides") and partial fatty acid glycerides having about equal amounts of monoglycerides and diglycerides (so-called "mono/diglycerides") can be used.

Other ingredients which are usual in cream type products can be added in appropriate amounts, if desired, for example 0.05 to 0.5% of lecithin by weight of the emulsion, which is favourable for improving the rigidity of the whipped cream, and from 3 to 20% of monosaccharides and/or disaccharides by weight of the emulsion, which can be used for sweetening purposes. Artificial sweeteners can also be employed.

Thus, a particular embodiment of the invention is a low calorie cream, which is an oil-in-water emulsion containing:

a) from 3 to 25% by weight of fat having an extrapolated melting dilatation of at least 1500 $mm^3/25g$ at 0°C, for example butter fat, interesterified palm kernel oil, hydrogenated fats and vegetable oils,
b) from 0.5 to 2.0% by weight partial fatty acid glycerides,
c) from 0.05 to 0.5% by weight of lecithin, and
d) an aqueous phase having a pH of from 4.2 to 5.5 and containing from 3 to 20% by weight of the emulsion of mono- and/or di-saccharides and from 0.5 to 4% of its weight of whey protein of which by weight at least 60% is in the form of a complex with an algal anionic polysaccharide, the amount of coagulable protein being less than 20% by weight of the total protein.

Another particular embodiment of the invention is a whippable high-PUFA cream, which is an oil-in-water emulsion containing:

a) from 25 to 50% by weight of fat having a PUFA content of at least 30 mole % and containing from 15 to 60% of its weight of a fatty acid triglyceride hard-stock, i.e. triglyceride having a melting point of at least 38°C,
b) from 0.5 to 2.0% by weight of partial fatty acid glycerides,
c) from 0.05 to 0.5% by weight of lecithin, and
d) an aqueous phase having a pH of from 4.2 to 5.5 and containing from 3 to 20% by weight of the emulsion of mono- and/or di-saccharides, and from 0.5 to 4% of its weight of whey protein of which by weight at least 60% is in the form of a complex with an algal anionic polysaccharide, the amount of coagulable protein being less than 20% by weight of the total protein.

The invention also provides a whipped emulsion comprising a dispersed gas phase, prepared by whipping an oil-in-water emulsion according to the invention. Such whipping can be carried out by whipping with a conventional household or industrial mixer using air as the gas to be dispersed, but also by applying a pressurised gas such as air, nitrogen and nitrous oxide, which whips the emulsion during the simultaneous release of aqueous oil emulsion and gas such as is provided in aerosol-packaged creams and by whipped-cream equipment in use in ice cream shops.

The oil-in-water emulsions of the present invention have the advantages that they show a good foam formation and are whippable in general within 2—3 minutes in contrast with many filled creams, i.e. creams containing vegetable fats, which often show rather long whipping times (up to 10 minutes and more). The low pH of the emulsions gives the advantage that the storage properties of the emulsions can be made much better than for conventional dairy whipping cream, as regards microbiological stability, formation of fat lumps, and viscosity.

The invention also provides a process for the preparation of an oil-in-water emulsion which comprises:

a) preparing an aqueous phase having a pH of from 4.2 to 5.5 and containing by weight of the aqueous phase, from 0.5 to 4% globular protein, the amount of coagulable protein being by weight less 20% of the total protein, and optionally from 3 to 20% of mono- and/or di-saccharides by weight of the emulsion,
b) mixing the aqueous phase with a non-protein emulsifier of the type that forms a flocculate at the pH of the aqueous phase in an amount sufficient to retain dispersed gas when the emulsion is whipped and with not more than 50%, and preferably from 25 to 50%, of fat by weight of the emulsion at a temperature at which the fat is liquid, and optionally with from 0.05 to 0.5% of lecithin by weight of the emulsion,
c) homogenising the mixture at a temperature at which the fat is liquid, and
d) pasteurizing by heat, and packaging the emulsion obtained.

The non-protein emulsifier and the lecithin can be added to the aqueous phase, but premixing with the fat is preferable to facilitate the emulsification of the fat.

By packaging is preferably meant filling into a container which is subsequently sealed. The pasteurisation can be carried out continuously or batchwise before packaging, but when the emulsion is to be sold in bottles or tins it is preferable that the unwhipped emulsion is packaged and then pasteurised while the package contents are moving with respect to the container. With substantially all globular protein present in the form of a complex with an algal anionic polysaccharide, emulsions according to the present invention have been sterilised successfully.

The emulsion can be whipped and then packaged, for example when the whipped emulsion is used as a topping on a ready-to-eat dessert. In such a process the emulsion is preferably cooled to from 0 to 10°C before whipping. If the application of the whipped cream needs pasteurisation of the product, the emulsion can conveniently be pasteurised before the cooling.

The invention is illustrated by the following Examples in which amounts are by weight unless stated otherwise.

Example 1

A fat phase of 32 parts maize oil, 8 parts interesterified palm kernel oil and 1 part C_{16} distilled monoglyceride was made at 60°C. An aqueous phase of 5 parts cream containing 40% milk fat, 5 parts sugar and 49 parts of a suspension of a complex of sodium alginate and undenatured whey protein, which suspension contained 2% protein, was made by mixing the ingredients at 60°C. The complex had been prepared as follows: 0.2% sodium alginate was added to cheese whey adjusted with caustic soda to a pH of 9 and dissolved while stirring for 15 minutes. Subsequently the pH was decreased to 3.0 by addition of hydrochloric acid. The preci-

pitated complex was isolated by centrifugation.

The fat phase was emulsified in the aqueous phase and the emulsion was homogenised and pasteurised.

After storage for 3 weeks at 5°C the cream was whipped within 3 minutes with a normal mixer and had a good rigidity and appearance. Although the pH of the whipping cream was 4.9, the product did not taste sour.

Examples 2 to 7

Examples 2 to 4 relate to recombined, low calorie dairy creams, and Examples 5 to 7 relate to low calorie filled creams. In Examples 2 to 4 butterfat (obtained by melting butter and separating the fat) was mixed with 0.95% glycerol mono-palmitate, 0.05% of a monoglyceride having an Iodine Value of 98 and an average carbon number of the fatty acid chain of about 18 marketed under the trade name Myverol 18-98 (Myverol is a Registered Trade Mark), and 0.1% lecithin; the percentages are by weight of the emulsion. Sucrose was added in an amount of 10% by weight of the emulsion to an aqueous phase containing 0.89% of its weight of whey protein in the form of a complex with sodium alginate and prepared as described in Example 1, and free whey protein incorporated by adding an appropriate amount of an electrodialysed whey protein concentrate containing 35% protein, and having a pH of 4.8. The amounts of butterfat and free whey protein are given below in Table 1. The fat phase and the aqueous phase were heated to 65—70°C, mixed and homogenised at 75 and 50 kg/cm², and the emulsion was filled into bottles which were sealed and pasteurised for 10 minutes at 90°C in such a way that the contents were moving with respect to the bottle. After storing for one night at 5°C samples were whipped with a Kenwood (Trade Mark) mixer in about 3 minutes, and their rigidity was tested by means of a penetrometer. The penetrometer value was determined as the depth in mm which a cone falls into the whipped cream measured with a penetrometer. The angle of the cone is 90°, the weight is 65.6 g and the fall time is 5 seconds. A lower penetrometer value corresponds with a more rigid whipped cream.

In Examples 5 to 7 the procedure was the same as above except that butterfat was replaced by an interesterified palm kernel oil.

TABLE 1

Ex.	% Fat	% Aqueous phase before addition of sucrose	% Free protein in aqueous phase	% Over-run	Penetrometer value
2	5	84	0.42	368	35
3	10	79	0.44	340	23
4	15	74	0.47	310	20.5
5	5	84	0.42	320	>36
6	10	79	0.44	322	32
7	15	74	0.47	328	23

The piping properties of the whipped cream of Examples 2 and 5 were reasonable and those of Examples 3, 4, 6 and 7 were good. The rigidity of the Examples was good even after 8 hours.

Example 8

A fat phase was made by mixing 20% maize oil, 3.9% butterfat (added as butter) 5% of a hard-stock consisting of a mixture of interesterified partially hydrogenated vegetable oils having a melting point of about 45°C, 0.95% glycerol monopalmitate, 0.05% Myverol 18-98 and 0.1% lecithin at about 65°C. The PUFA content of the fat was about 33%. An aqueous phase (59%) containing 2.67% of its weight of free whey protein incorporated by addition of the appropriate amount of electrodialysed whey protein concentrate containing 35% protein was mixed with 10% sucrose. The pH of the aqueous phase was 4.8. Unless otherwise stated the percentages are by weight of the emulsion. The fat phase and the aqueous phase containing the sucrose were mixed at about 65°C and the mixture was homogenised at 75 and 50 kg/cm², filled into bottles and pasteurised (10 minute at 90°C). After storing for one night at 5°C a sample was whipped as described for Examples 2—7. The overrun was 208%, the whipped cream showed reasonable piping properties, but less rigidity than the creams of Examples 2—7.

Example 9

The procedure of Example 8 was repeated except that part of the whey protein was in the form of a complex with sodium alginate prepared as described in Example 1 (0.89% whey protein in complexed form and 1.78% of free whey protein instead of 2.67% free whey protein). The overrun was 173%, the rigidity was similar too, but the piping pro-

perties of the whipped cream were slightly better than those of the cream according to Example 8.

Example 10

A recombined dairy cream was made by mixing at about 60°C 30% butter, 1% partial palmitic acid glyceride having a monoglyceride content of more than 90%, 10% sucrose, and 59% of an aqueous phase having a pH of 4.95 and containing 1% of its weight of whey protein in the form of a complex with sodium alginate prepared as described in Example 1. The mixture was homogenised at about 60—70°C at 175 and 100 kg/cm², filled into bottles which were sealed and pasteurised while the contents were moving with respect to the container (10 min. at 90°C). After storing overnight at 5°C the emulsion was whipped in 2 minutes and gave a whipped cream having an overrun of 250%, a penetrometer value of 22 and a good rigidity.

Examples 11 and 12

The procedure of Example 10 was repeated with the exception that 24% maize oil and 6% of the hard-stock used in Example 8 were used instead of butter. The PUFA content of that fat was about 41%. An aqueous phase was used containing in addition 0.60% of its weight of free protein incorporated by addition of partially hydrolysed wheat gluten (Example 11) or 0.54% of its weight of dried egg white containing 80% egg white protein (Example 12). The pH of the aqueous phase was 4.95 (Example 11) and 4.8 (Example 12).

	Example 11	Example 12
Whipping time	4 minutes	2 minutes
Overrun	178%	165%
Penetrometer value	23.5	25
Rigidity	good	reasonable

Example 13

Edible emulsions were made following the procedure of Example 8 by mixing a fat mixture containing 20% maize oil, 5% of the hard-stock used in Example 8, 4.7% butter, 0.95% glycerol monopalmitate, 0.05% Myverol 18-98 and 0.1% lecithin with 10% sucrose and an aqueous phase containing 0.89% of its weight of whey protein in the form of a complex with sodium alginate prepared as described in Example 1 and 1.05% of its weight of free whey protein incorporated by adding the appropriate amount of an electrodialysed whey concentrate containing 35% protein. A series of samples of different pH in the range of 4.3 to 5.5 at intervals of 0.2 were made. After whipping the products having a pH within the range of 4.6 to 5.4 gave creams having an overrun varying from 245% to 285% and a penetrometer value varying from 32 mm to 36 mm.

Example 14

A fat phase containing 32% maize oil, 8% interesterified palm kernel oil and 0.5% of a distilled, fully hardened sunflower seed fatty acid monoglyceride having a monoglyceride content of at least 90% and 59.5% of an aqueous phase having a pH of 4.2 and containing 2% of its weight of whey protein in the form of a complex with sodium alginate prepared as described in Example 1 were separately heated to 65—70°C, and then mixed. The mixture was homogenised at 175 and 100 kg/cm², filled into bottles which were sealed and pasteurised at different temperatures (70, 80, 90 and 100°C) for 10 minutes. The products were whipped after storing over-night at 5°C. Overrun from 157 to 167%, and penetrometer values from 28 to 31 were obtained and the piping properties were good. The whipped products did not give serum drainage.

Example 15

The procedure of Example 10 was repeated with the exception that 24% maize oil and 6% of the hard-stock used in Example 8 were used instead of 30% butter. The aqueous phase had a pH of 4.8 and contained 1% of whey protein but complexed with carrageenan instead of sodium alginate. The complex was prepared by dissolving 0.2% carrageenan in cheese whey adjusted at pH 6.4 by stirring for 15 minutes at 60°C. The complex was formed after cooling to 20°C and acidifying to pH 2 with hydrochloric acid. The complex was isolated by centrifuging, redispersing in water and spray-drying the dispersion yielding a powder containing 30% protein. After whipping for 3 minutes the overrun was 194%, the penetrometer value more than 36 mm and the rigidity was rather low.

WHAT WE CLAIM IS:—

1. An oil-in-water emulsion which has been pasteurised by heat comprising not more than 50% by weight fat and an aqueous phase having a pH of from 4.2 to 5.5 and containing from 0.5 to 4% globular protein as hereinbefore defined by weight of the aqueous phase, less than 20% of the total amount of protein being coagulable and a

non-protein emulsifier of the type that forms a flocculate in water at the pH of the aqueous phase in an amount sufficient to retain dispersed gas when the emulsion is whipped.

2. An emulsion according to Claim 1, in which the pH is in the range of from 4.6 to 5.4.

3. An emulsion according to Claim 2, in which the pH is from 4.7 to 5.0.

4. An emulsion according to Claim 1, in which the pH is from 4.2 to 4.9.

5. An emulsion according to any one of Claims 1 to 4, in which the globular protein content of the aqueous phase is from 1.0 to 2.5% by weight of the aqueous phase.

6. An emulsion according to any one of Claims 1 to 5, in which the globular protein is whey protein.

7. An emulsion according to any one of Claims 1 to 6, in which at least part of the globular protein is present in the form of a complex with an anionic polysaccharide.

8. An emulsion according to any one of Claims 1 to 6, in which at least part of the globular protein is present in the form of a complex with an algal anionic polysaccharide.

9. An emulsion according to Claim 8, in which substantially all globular protein is present in the form of a complex with an algal anionic polysaccharide.

10. An emulsion according to any one of Claims 1 to 9, in which by weight from 0.3 to 2.0% emulsifier is present by weight of the emulsion.

11. An emulsion according to any one of Claims 1 to 10, in which the emulsifier is a partial palmitic acid glyceride.

12. An emulsion according to any one of Claims 1 to 11, which contains by weight from 3 to 20% mono- and/or disaccharides.

13. An emulsion according to any one of Claims 1 to 12, in which the fat content is from 25 to 50% by weight.

14. An emulsion according to Claim 13, in which the fat has a PUFA-content as hereinbefore defined of at least 30 mole %.

15. An emulsion according to Claim 13 or Claim 14, in which the fat contains by weight from 15 to 60% fatty acid triglyceride hardstock as hereinbefore defined.

16. An emulsion according to Claim 1, and containing:

(a) from 25 to 50% by weight of fat having a PUFA-content as hereinbefore defined of at least 30 mol % and containing from 15% to 60% of its weight of a fatty acid triglyceride hardstock as hereinbefore defined,

(b) from 0.5 to 2.0% by weight of a partial fatty acid glyceride,

(c) from 0.05 to 0.5% by weight of lecithin, and

(d) an aqueous phase having a pH of from 4.2 to 5.5 and containing from 3 to 20% by weight of the emulsion of mono- and/or di-saccharides and whey protein of which at least 60% by weight is in the form of a complex with an algal anionic polysaccharide.

17. An emulsion according to any one of Claims 1 to 12, in which the fat content is from 3 to 25% by weight.

18. An emulsion according to Claim 17, in which the fat has an extrapolated melting dilation of at least 1500 $mm^3/25g$ at 0°C.

19. An emulsion according to Claim 1, and containing:

(a) from 3 to 25% by weight of fat having an extrapolated melting dilation of at least 1500 $mm^3/25g$ at 0°C,

(b) from 0.5 to 2.0% by weight of a partial fatty acid glyceride,

(c) from 0.05 to 0.5% by weight of lecithin, and

(d) an aqueous phase having a pH of from 4.2 to 5.5 and containing from 3 to 20% by weight of the emulsion of mono- and/or di-saccharides and whey protein of which at least 60% by weight is in the form of a complex with an algal anionic polysaccharide.

20. A whipped emulsion according to any one of Claims 1 to 16, and comprising a dispersed gas phase.

21. A whipped emulsion according to any one of Claims 12 to 19, and comprising a dispersed gas phase.

22. An oil-in-water emulsion substantially as described in Example 1.

23. An oil-in-water emulsion substantially as described in any one of Examples 2 to 15.

24. A process for the preparation of an oil-in-water emulsion, which comprises:

(a) preparing an aqueous phase having a pH of from 4.2 to 5.5 and containing from 0.5 to 4% globular protein by weight of the aqueous phase and less than 20% of the total amount of protein being coagulable protein,

(b) mixing the aqueous phase with a non-protein emulsifier of the type that forms a flocculate at the pH of the aqueous phase in an amount sufficient to retain dispersed gas when the emulsion is whipped and with not more than 50% fat by weight of the emulsion at a temperature at which the fat is liquid,

(c) homogenising the mixture at a temperature at which the fat is liquid, and

(d) pasteurising, by heat, and packaging the emulsion obtained.

25. A process according to Claim 24, where the aqueous phase contains from 3 to 20% of mono- and/or di-saccharides by weight of the emulsion.

26. A process according to Claim 24 or Claim 25, in which the unwhipped emulsion

is packaged and then pasteurised while the packaged contents are moving with respect to the container.

27. A process according to Claim 24 or Claim 25, in which the emulsion is whipped and then packaged.

28. A process according to Claim 27, in which the emulsion is cooled to from 0 to 10°C before whipping.

29. A process according to Claim 28, in which the emulsion is pasteurised before the cooling.

30. A process according to any one of Claims 24 to 29, in which the emulsion contains by weight, from 3 to 50% fat.

31. A process according to Claim 30 in which the emulsion contains by weight from 25 to 50% fat.

32. A process for preparing an oil-in-water emulsion substantially as described in Example 1.

33. A process for preparing an oil-in-water emulsion substantially as described in any one of Examples 2 to 15.

34. An oil-in-water emulsion which has been obtained by a process according to any one of Claims 24 to 33.

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